High order predictor-corrector schemes using projection-techniques for non linear elastic problems

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The most widely used techniques to compute the solution paths of non-linear problems are predictor-corrector algorithms. The principle of these strategies is to follow the branch in a stepwise manner via a succession of linearizations and some iterations to achieve the equilibrium.

Improved high-order predictor corrector algorithms have been recently proposed [1]. The predictors and the correctors are based on homotopys techniques, perturbation techniques and Padé approximants. This extends the Asymptotic Numerical Method, which is an efficient high-order path following technique without corrector [2]. In the proposed high-order correctors [3] [4], one can define a high order Newton algorithm that is efficient, robust and that often converges after a single iteration. Others algorithms denoted as L* algorithms do not require any triangulation of a large matrix, but they are not as efficient as the previous one.

In this presentation, a reduced basis technique is used to improve the latter method, that is a sort of Newton method on a reduced subspace and a sort of L* algorithm on the whole space. For instance within the Asymptotic Numerical Method, the vectors issued from the perturbation techniques provide such a subspace. The equation of the problem is split into two equations, by projecting it on the reduced subspace and its orthogonal. The key point is a new class of homotopy transformation. This algorithm is inexpensive, because only an arbitrary matrix L* and a small matrix have to be inverted.

A few benchmarks emanating from shell buckling analysis are revisited to evaluate the efficiency and the reliability of the proposed algorithms.

References

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